NAS Architecture

Forum on the Future of Aviation
Transportation Research Board

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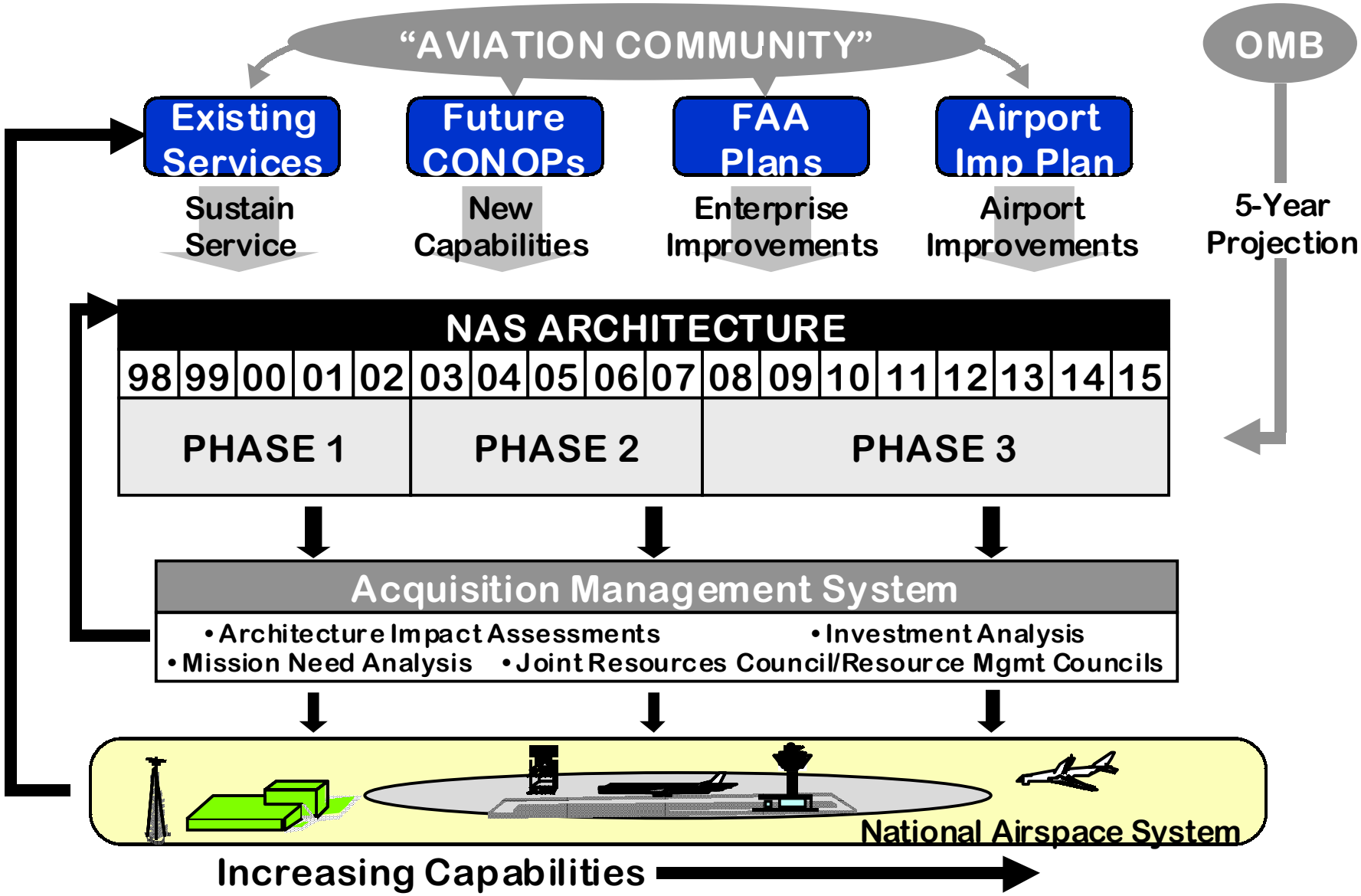
NAS Modernization Process



Navigation Highlights

Using satellite-based services for exceptional accuracy, increased operational safety, and expanded airport coverage

Phase 1 (1998 - 2002) - Wide Area Augmentation System (WAAS)

- Signals provided for domestic En Route navigation, non-precision, and precision approaches (within operational restrictions)
- Additional ground monitoring and control stations deployed
- Sufficient ground monitoring and geostationary satellites deployed, making operational restrictions unnecessary

Phase 2 (2003 - 2007)

- Local Area Augmentation System (LAAS) deployed at approximately 150 airports to provide Cat-I/II/III precision approach capability
- FAA/Aviation Community will determine transition schedule for gradual reduction of ground-based navigation systems

Phase 3 (2008 - 2015)

- Continued transition from ground-based navigation commensurate with WAAS and WAAS/LAAS avionics equipage

Communications Highlights

Improving quality and reliability through integrated digital communications

Phase 1 (1998 - 2002)

- Maintain and augment existing air-ground communications
- Initial Controller-Pilot Data Link Communications (CPDLC) message set (Build 1) implemented via Very High Frequency Digital Link-2 (VDL)
- Two-way data link via satellite and HF established over ocean

Phase 2 (2003 - 2007)

- VDL-3 digital voice operations in high and super high En Route sectors
- CPDLC message set expanded on VDL-2

Phase 3 (2008 - 2015)

- CPDLC message set available via VDL- 2 and VDL- 3
- VDL- 3 voice and data operations available in selected high-density terminal areas
- UHF analog radio service available to DoD
- VHF analog voice service available in many low-density areas for General Aviation

Surveillance Highlights

Installing new technologies and expanding coverage

Phase 1 (1998 - 2002)

- New digital terminal radars and new En Route secondary surveillance radars installed
- Weather and Radar Processor (WARP) data displayed on DSR will allow for decommissioning of older primary En-Route radars
- New airport surface surveillance radar Airport Surface Detection Equipment (ASDE-3) along with a conflict detection tool, Airport Movement Area Safety System (AMASS) installed
- Evaluate and select Automatic Dependent Surveillance-Broadcast (ADS-B) air-air technologies with Aviation Community
  - "1090 Squitter" for Traffic Alert and Collision Avoidance System (TCAS) equipped aircraft (2000)
  - Other technologies as determined by community

Phase 2 (2003 - 2007)

- Complete installation of all new terminal and En Route radars
- Long-Term implementation of ADS (air-air and air-ground)
  - Considers global interoperability requirement
  - Begin deployment of ~900 ground stations

Weather Highlights

Having timely and accurate weather data for controllers and pilots

Phase 1 (1998 - 2002)

- Integrated Terminal Weather System (ITWS) provides Terminal Doppler Weather Radar (TDWR) data to Terminal Radar Approach Control (TRACON) supervisor
- WARP provides Next Generation Weather Radar (NEXRAD) data to ARTCC controllers
- Flight Information Service - weather products available via data link to cockpit

Phase 2 (2003 - 2007)

- Upgrades and enhancements to WARP, TDWR, and Airport Surveillance Radar-Weather System Processor (ASR-WSP)

Phase 3 (2008 - 2015)

- Severe weather location and movement data shared among terminal and Air Route Traffic Control Center (ARTCC) controllers Integrated Terminal Weather System Pre-Planned Product Improvement (ITWS P^3I)

Automation Highlights

Free Flight Phase 1: Deploying advanced capabilities to accelerate user benefits and assess modernization risks

Free Flight Phase 1 (1998 - 2002)

Collaborative Decision Making (CDM) provides information exchange with users

- User Request Evaluation Tool (URET) provides conflict probe for controllers
- Traffic Management Advisor (TMA) provides flight metering for controllers
- Passive Final Approach Sequencing Tool (pFAST) provides sequencing and spacing for controllers
- Surface Movement Advisor (SMA) provides enhanced aircraft information and information exchange for controllers and users
- CPDLC provides message exchange between controllers and pilots

Automation Highlights (continued)

Phase 1 (1998 - 2002) - Sustain Infrastructure

- En Route - Display System Replacement (DSR), Host/Oceanic Computer System Replacement (HOCSR), Direct Access Radar Channel (DARC-R), Peripheral Adapter Module Replacement Item (PAMRI-R)
- Terminal - Common Automated Radar Terminal System (ARTS), Standard Terminal Automation Replacement System (STARS)

Phase 2 (2003 - 2007)

- Begin national deployment of Free Flight Phase 1 (FFP1) tools

Phase 3 (2008 - 2015)

- NAS-wide information sharing provides real time data to users

NAS Modernization Capabilities

Sixteen Capabilities

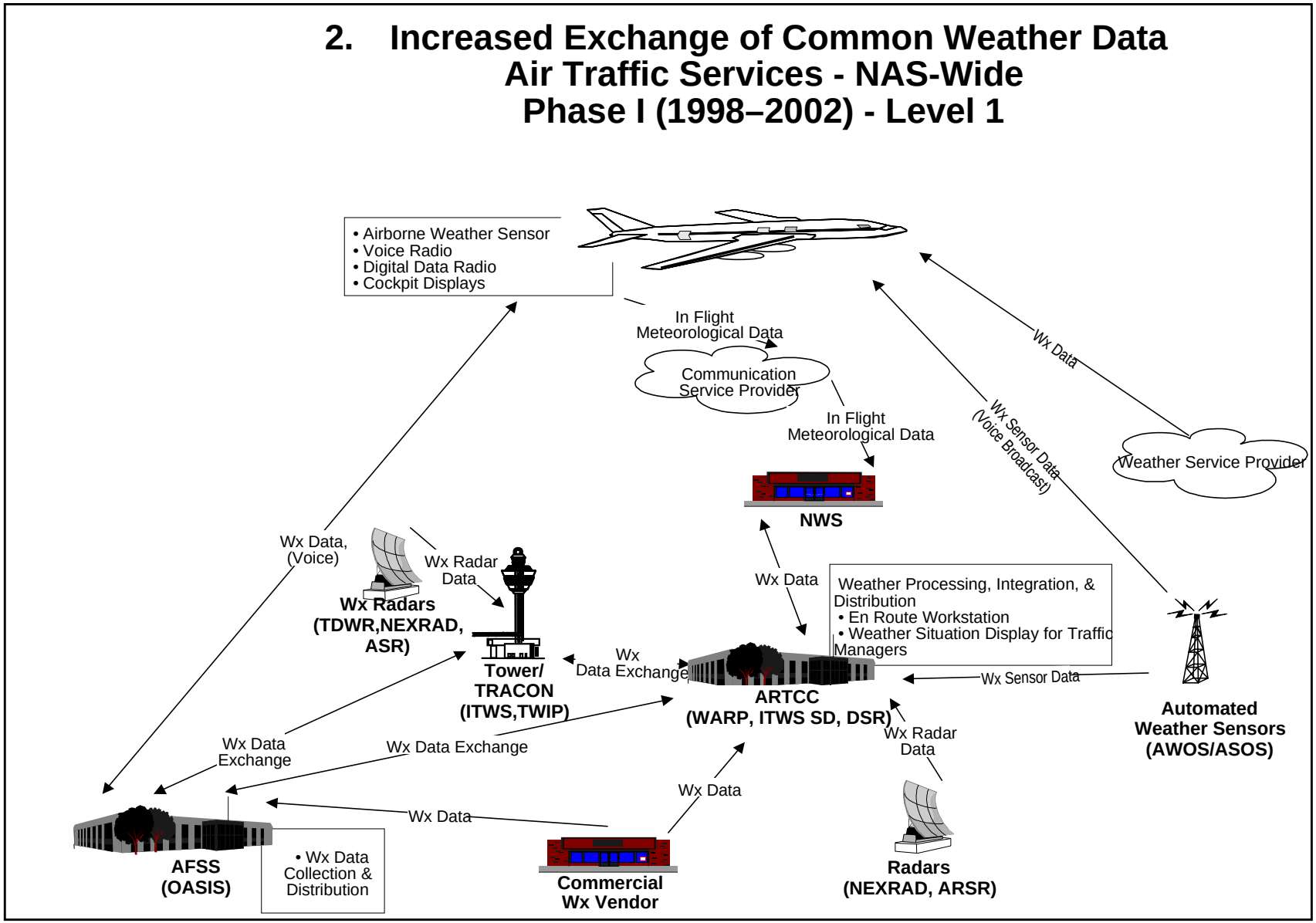
1. Increased Navigation and Landing Position Accuracy and Site Availability
2. Increased Exchange of Common Weather Data
3. Improved Aircraft Positional Accuracy Reporting to Service Providers
4. Increased Self-Separation by Properly Equipped Aircraft
5. Increased Surveillance Area Coverage
6. Increased Digital Voice and Data Communications Among Service Providers and Pilots
7. Improved Flight Plan Negotiations
8. Improved Arrival/Departure Sequencing and Spacing for Tactical Traffic Flow

NAS Modernization Capabilities (continued)

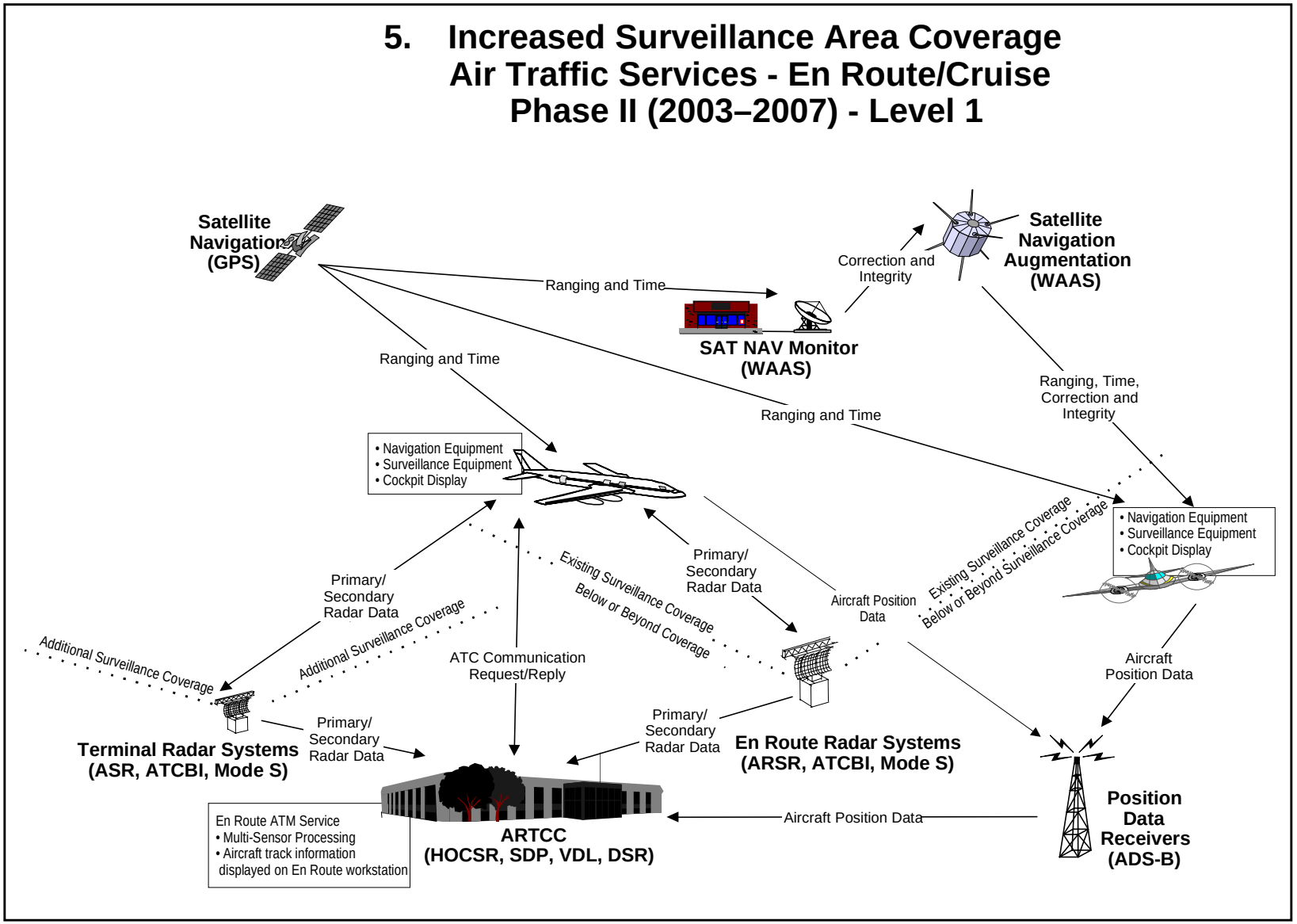
9. Increased Flexibility in Flying User- Preferred Routes
10. Increased Oceanic Airspace Capacity
11. Improved Surface Traffic Management
12. Increased Low- Altitude Direct Routes
13. Increased Availability of Aeronautical Information to Service Providers and NAS Users
14. Improved CDM Between Service Providers and NAS Users for Strategic Planning
15. Increased Ability To Support Search and Rescue Activities
16. Improved Infrastructure Maintenance Management

✷ *Not all capabilities across all phases of flight (Tower/Airport Surface, Arrival/Departure, En route/Cruise , and Oceanic)*

Capabilities Level 1 Diagram

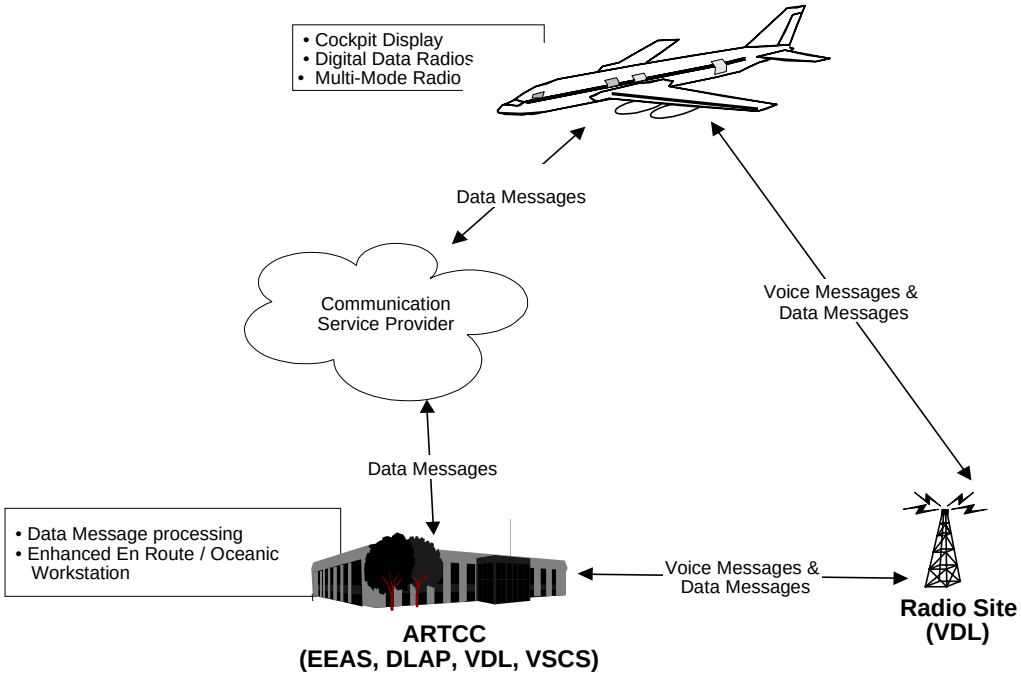


Capabilities Level 1 Diagram



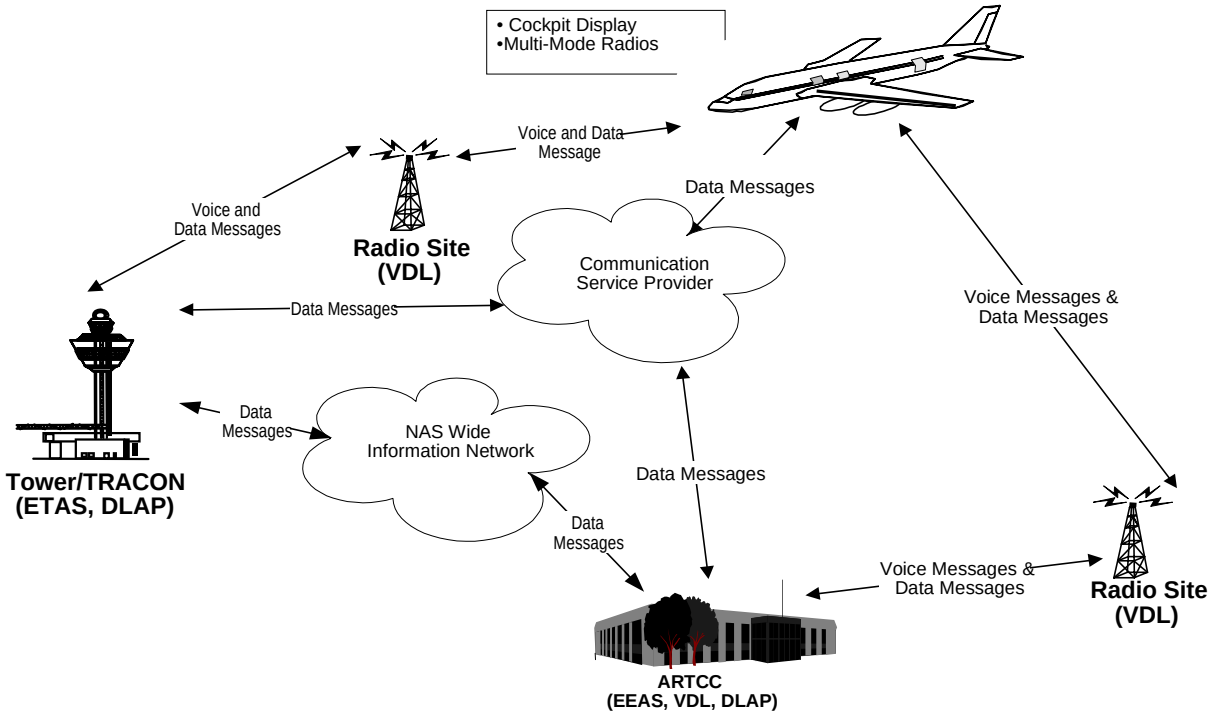
Capabilities Level 1 Diagram

6. Increased Digital Voice and Data Communications Between Service Providers and Pilots Air Traffic Services - En Route/Cruise Phase III (2008–2015) - Level 1



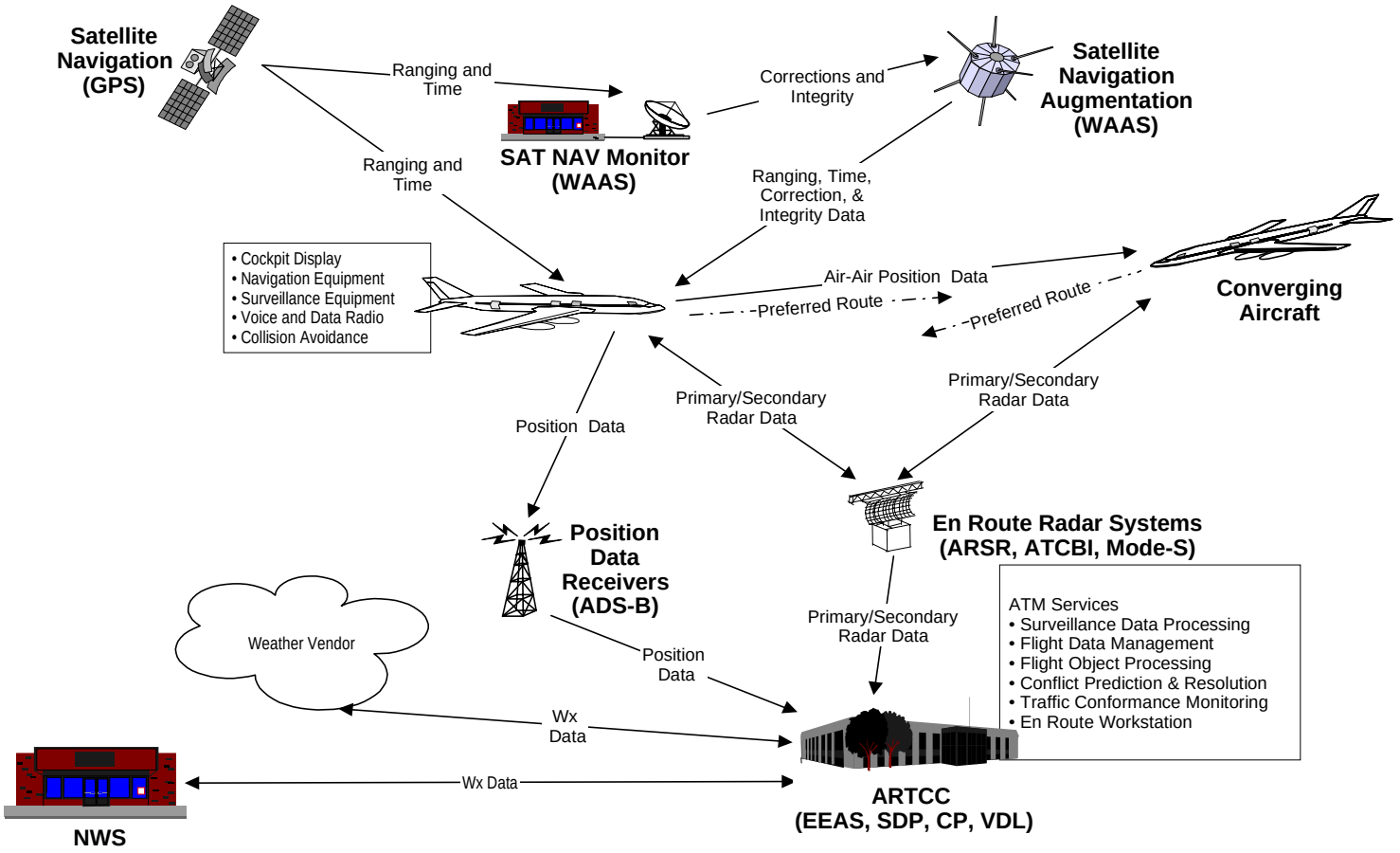
Capabilities Level 1 Diagram

6. Increased Digital Voice and Data Communications Between Service Providers and Pilots Air Traffic Service, NAS-Wide Phase III (2008-2015)



Capabilities Level 1 Diagram

9. Increased Flexibility in Flying User Preferred Routes
Air Traffic Services - En Route/Cruise
Phase III (2008–2015) - Level 1



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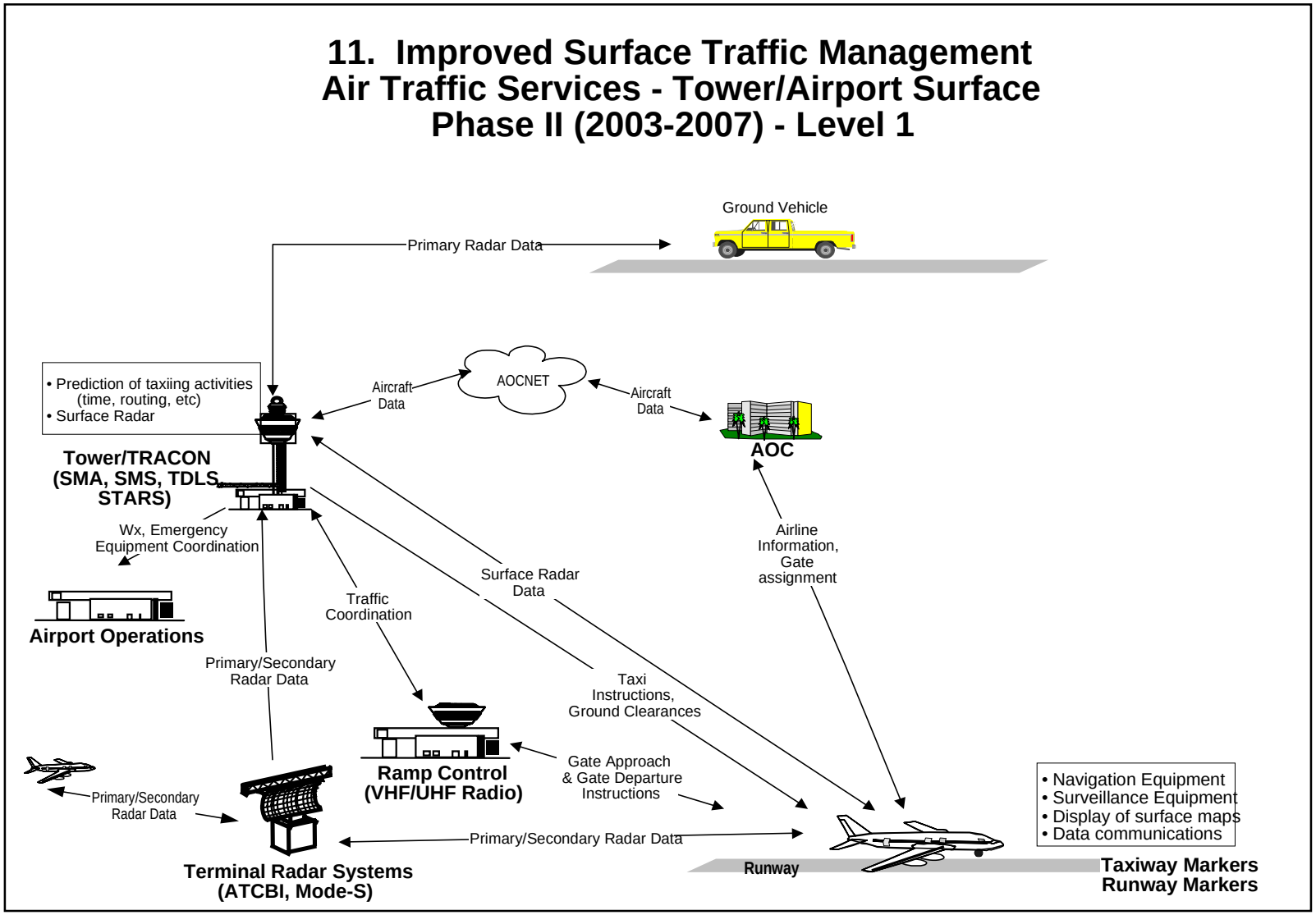

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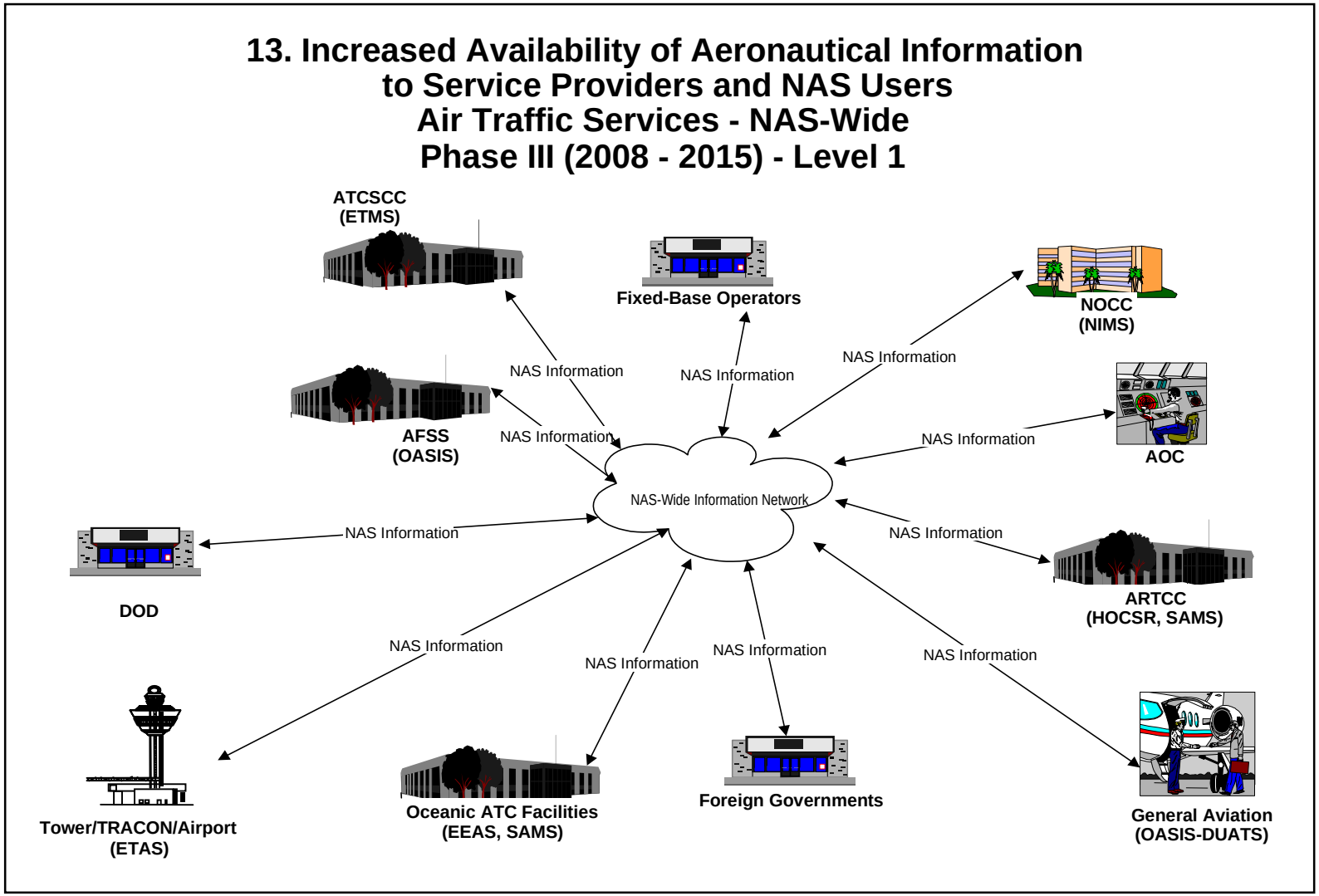

BACK-UP

NAS Modernization Phases

PHASE 1 (1998-2002)

Continue NAS Modernization and implement limited Free Flight prototypes.

Complete Air Traffic Control Decision Support Systems infrastructure sustainment and begin "opening" of systems such as Host, STARS, and TFM. Collaboration between Airline Operations Center and the Air Traffic Control System Command Center is underway. Begin Installing new infrastructure to support more precise position reporting and and less structured routes. FFP1 CCLD deployed and procedural changes made to enhance operations.

KEY TECHNOLOGIES

CPDLC | GPS/WAAS | URET CCLD | ADS-B A/A | Passive FAST | STARS

- Controller Pilot Data Link Communications Build 1 (CPDLC)
- Display System Replacement (DSR)
- Weather and Radar Processor (WARP)
- Initial Collaboration w/ Airlines
- Passive Final Approach Spacing Tool (FAST)
- Initial Surface Movement Advisor (SMA)
- User Request Evaluation Tool Core Capabilities Limited Deployment (CCLD)
- Initial CTAS deployment with Traffic Management Advisor (TMA)Single Center
- Navigation and Precision Approaches via GPS/WAAS
- Host and Oceanic Computer System Replacement (HOCSR)
- Standard Terminal Automation Replacement System (STARS)
- Air- to-Air situational awareness via Automatic Dependent Surveillance Broadcast (ADS-B)
- Initial Flight Information System (FIS)
- En Route Navigation via Global Position in System/ Wide Area Augmentation System (GPS/WAAS)

NAS Modernization Phases

PHASE 2 (2003-2007)

Continue NAS modernization and begin transition to Free Flight.

New "open" DSS systems are installed, and new CNS infrastructure being deployed. Free Flight concepts are being implemented as procedural changes are made to take advantage of more collaboration with users.

KEY TECHNOLOGIES

Limited Next Generation Air-Ground Communications Systems (NEXCOM)

WAAS/LAAS

ADS-B Ground Stations

Integrated Terminal Weather System (ITWS)

STARS P3I

Conflict Probe (CP)

- 50/50 Oceanic separation in Pacific
- Conflict Probe
- CPDLC Build 2
- ADS available in non-radar areas
- CAT II/III landings via GPS/WAAS/LAAS
- Full NAS deployment of CTAS TMA Multi-Center and Descent Advisor
- ADS-B Data used for ATC

NAS Modernization Phases

PHASE 3 (2008-2015)

Achieve Limited Free Flight operations.

New integrated ATC and TFM DSS tools allow greater sharing of 4-D flight profiles throughout the NAS enabling greater flexibility and planning with the users. Capacity is increased as more accurate position reports are incorporated onto DSS tools. Installation of CNS completed.

KEY TECHNOLOGIES

Full NEXCOM •Full CP Next Generation En Route Automation A-FAST/WV NAS Info System

- Common En Route / Oceanic ATC
- NAS Wide Information Sharing
- NAS-Wide Data Link
- Interactive Airborne Refile
- Voice via digital radios for High Alt En Route
- Active FAST with Wake Vortex
- Full use of digital communications for voice and data En Route
- Full Collaborative Decision Making